

## CLAIMS

1. An electron emission device comprising:

an electron emitter that includes a lower electrode, an upper  
5 electrode made of a thin film, and a semiconductor layer formed  
between the lower electrode and the upper electrode, a surface of the  
upper electrode exposed to an external space;

a counter electrode that is provided to oppose the upper  
electrode across the external space;

10 a fine particle charging voltage control section that applies an  
electron emitting voltage for accelerating electrons in the semiconductor  
layer, passing the electrons through the upper electrode, and emitting  
the electrons to the external space, or a voltage for charging fine  
particles attached to the surface of the upper electrode between the  
15 upper electrode and the lower electrode; and

a flying voltage control section that applies, between the upper  
electrode and the counter electrode, a voltage for allowing the charged  
fine particles to fly from the surface of the upper electrode to the counter  
electrode,

20 whereby providing the electron emission device with a cleaning  
function.

2. The electron emission device according to claim 1, wherein  
the semiconductor layer is a porous silicon semiconductor layer in  
25 which a part of or all of polysilicon is made porous.

3. The electron emission device according to claim 1, wherein the counter electrode has a semiconductive layer or an insulating layer formed on its surface.

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4. The electron emission device according to claim 1, wherein the flying voltage control section applies a pulsed voltage so that the counter electrode has a positive potential relative to the upper electrode.

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5. The electron emission device according to claim 1, wherein the flying voltage control section operates a control to apply the voltage having a first voltage value to the external space between the upper electrode and the counter electrode, and

after the fine particle charging voltage control section applies a

15 predetermined voltage between the upper electrode and the lower electrode to charge the fine particles attached to the surface of the upper electrode, the flying voltage control section operates a control to apply the voltage having a second voltage value higher than the first voltage value, the second voltage value having such a magnitude that  
20 allows the charged fine particles to fly from the upper electrode to the counter electrode and that atmospheric discharge does not occur, and

the fine particle charging voltage control section operates a control to either apply a voltage having an opposite polarity to a polarity of the electron emitting voltage or apply no voltage between the upper  
25 electrode and the lower electrode, thereby allowing the charged fine

particles to fly from the surface of the upper electrode to the counter electrode.

6. The electron emission device according to claim 1, wherein  
5 the flying voltage control section is constructed to be capable of setting the polarity of the voltage applied between the upper electrode and the lower electrode to either positive or negative,

the flying voltage control section operates a control to apply the voltage having a second voltage value higher than the first voltage value,  
10 the second voltage value having such a magnitude that allows the charged fine particles to fly from the upper electrode to the counter electrode and that atmospheric discharge does not occur, and

the fine particle charging voltage control section operates a control to either apply a voltage having an opposite polarity to a polarity  
15 of the electron emitting voltage or apply no voltage between the upper electrode and the lower electrode, thereby allowing the charged fine particles to fly from the surface of the upper electrode to the counter electrode.

20 7. The electron emission device according to claim 1, wherein the flying voltage control section applies a voltage between the upper electrode and the counter electrode when the electrons are not emitted from the electron emitter so that the surface of the upper electrode of the electron emitter is negative.

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8. The electron emission device according to any one of claims 1 to 7, for use in a laser printer or a digital copying machine.

9. The electron emission device according to any one of claims 1 to 8, wherein the fine particles include dust such as toner and paper particles.